



Promoting Techno-Scientific Biomedical Communication in Russia: Pro-government Non-profit Organizations

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Specialty section:

This article was submitted to
Health Communication,
a section of the journal
Frontiers in Communication

Received: 04 January 2022

Accepted: 25 February 2022

Published: 06 July 2022

Citation:

Marchenko AN and Bykov IA (2022)
Promoting Techno-Scientific
Biomedical Communication in Russia:
Pro-government Non-profit
Organizations.
Front. Commun. 7:848578.
doi: 10.3389/fcomm.2022.848578

The rapidly expanding e-health market tends to reinvent the roles of science, entrepreneurship, and state. However, the results of such reinvention remain unclear. This study investigates the decade-long history (2011–2021) of the promotion of techno-scientific biomedical communication by pro-government non-profit organizations in Russia. In 2021, the World Bank pointed out that digital technologies have played a critical role in the pandemic in Russia and Russia's economic recovery is gathering pace. Thus, Russia tends to correspond to many other emerging health markets. We compare texts from non-profit organizations' websites and Facebook accounts with official state actions and the national mass media health agenda. The instruments that were used for text mining were topic modeling with latent Dirichlet allocation and an algorithm for keyphrase relationship visualization. The results revealed that promotion started no later than 2011 as a general private initiative in health. Throughout the state reforms and geopolitical crisis of 2014, in 2017–2019 digitalization was finally chosen as a model for the healthcare system. Simultaneously, the idea of digital reform for the health system was disseminated by the mass media. The pandemic drew attention to this communication, but it did not create significant change. Pro-government non-profit organizations continue to promote new directions for biomedical communication in Russia.

Keywords: media studies, digitalization and e-health, Russia—economic development and policies, public relations (PR), healthcare system and technologies, biomedical

INTRODUCTION

The broad context of this study includes changes in forms and modes of communication between states, science, and entrepreneurship during the pandemic. These changes have created new actors, forms of participation, and new roles for infrastructure and governance. The pandemic has questioned the fundamental elements of the current life, and radically altered the social order; since “social interrelations, the economic dynamics... have been minimized and emptied” (Coca and Cárcel, 2021). In the long run, it may affect greatly some businesses and perhaps some social norms and values as well (Khan et al., 2022). In these conditions, features of health communication have a significant impact on perceiving people's relationships.

The rapid increases in communication related to digital healthcare solutions tends to create completely novel social and economic relations. However, one should realize that “not recognizing that novelty needs the familiar and already tried to contextualize what novelty means has created a fixation on the new that undermines the understanding of current events” (Zelizer, 2019). Therefore, according to our hypothesis, communication between states, science, and entrepreneurship has to be discovered during the period of a pandemic, but is rooted in long-term communication, which “assists in public understanding and acceptance of national goals” (Schramm, 1964). Long-term communication creates, maintains, and transforms social and economic practices (Carey, 2009).

This study tests this hypothesis in the context of decade-long health communications (2011–2021) in Russia. The study aims to explore the promotion of techno-scientific biomedical communication by pro-government non-profit organizations (NPOs), such as the HealthNet roadmap of the National Technological Initiative (NTI) and the Agency for Strategic Initiatives (ASI). The aim includes the following research questions. (1) When did the health communications of these NPOs begin and what were their main stages of development? (2) What are the determinants of change (i.e., international, state, or public)? (3) What is the extent of the influence of such communication on the national health agenda generally?

The significance of this study lies in the current successes and failures of the Russian economy. Controversial though it may seem, despite a long chain of problems, such as the stagnation of people’s incomes (Euromonitor, 2021) and the state’s economic footprint (World Bank, 2021, p. 40), experts have pointed out that some successes occurred during the pandemic. The World Bank suggests that digital technologies played a critical role in this regard during the pandemic in Russia. In 2021, ICT exports were on the rise, expanding by 8.1% in value in 2020 (World Bank, 2021, p. 9). The annual growth rate of the Russian Digital Health market is expected to be 13.97% in 2021–2025, which is higher than the worldwide growth rate (13.45%; Statista, 2021). The lockdown accelerated the adoption of a new law allowing the sale of OTC and some pharmaceutical products on the Internet (Euromonitor, 2021).

The Institute for Statistical Studies and Economics of Knowledge has issued a report which describes “the digital maturity of healthcare” in Russia (ISSEK, 2020). It argues that there is a positive dynamic of financial support for the digitalization of the health system, the actual prices of which increased by 1.3 times between 2020 and 2021 (ISSEK, 2021a). Business spending on innovations increased by 1.7% in 2020, and their share in total sales reached 2.3% (vs. 2.1% in 2019), which corresponds to leading European countries (Finland, 2.4%; France, 2.3%; Austria, 2.1%; ISSEK, 2021b). At the same time, state-driven “national projects remain the main tool for accelerating long-term potential growth” (World Bank, 2021, p. 40). It is not clear when the economy changed: before or during the pandemic? What are the roles of different actors and within them?

Several studies have explored the traditions of science communication in Russia (Balashova, 2018) and soviet-based principles of biotechnology governance (Novossiolova, 2017). These publications propose paying more attention to state-driven actions. These actions can be official, based on laws and programs, or communication-based. Studies that have investigated official actions reveal the shift from the dissolution of the Soviet system of public healthcare (Semashko model of 1930s) to the “shock therapy” of the first half of the 1990s, and to the creation of a stable system in the 2000s and the beginning of the 2010s (see **Table 1** and Popovich et al., 2011; Cook, 2015; Shishkin, 2017; Shishkin and Zaslomova, 2018).

Endaltseva (2020) points out that the promotion of high-tech medicine is related to governmental institutions concerns over import substitution resulting from the current geopolitical crisis. She observed the roles of the state, non-government organizations (NGOs), education, and research sectors in the development of communication. She concluded that the patient movement “plays a mediator role” among the government, business, and public (Endaltseva, 2020, p. 212).

Health reforms of the 2010s have been underexplored from a long-term perspective. For example, Gordeev et al. (2011) observed changes in quality, equity, efficiency and sustainability in public healthcare provision from 1991 to the start of the 2010s. Unlike Gordeev’s study, which used a systematic literature review approach and focused on the financial results of healthcare reform in Russia, this study offers an original empirical study of techno-scientific biomedical communication with data collected from websites and Facebook (Meta). In regard to continuing and combining Gordeev’s data, we explore the communication aspects of the next decade (2011–2021) for an evidence-based evaluation of the changes. Based on the analysis of the decade-long communication between the state, science, and business regarding NPOs communication, we reconstructed and analyzed the roles of NPOs in implementing techno-scientific biomedical communication in Russia.

Pro-government NPOs in Russia

Balashova and Novossiolova point out the importance of state-driven actions in innovative development in Russia (Novossiolova, 2017; Balashova, 2018). Several influential pro-government NPOs contribute to innovative development: the NTI, the ASI, the Skolkovo Innovation Center, the Russian Venture Company, the Foundation for Assistance to Innovations, and the Direct Investment Fund, which was part of the development of the Sputnik V COVID-19 vaccine. In 2019–2020, the NTI received RUB 1578 million (approximately USD 21.5 million) from the state, three-quarters of this in March 2020; the money was provided to resolve issues that arose because of the pandemic (PublSpending, 2021a). For comparison, the ASI received approximately RUB 800 million (approximately USD 11 million) in 2014–2020, which was distributed fairly equally over that time (PublSpending, 2021b).

The NTI and ASI can be represented as promoters of pro-government communication because, by statute, their main activity is the research of the market and public opinion, unlike, for example, Skolkovo or the Foundation for Assistance

TABLE 1 | History of official actions in the Russian health field.

#	Date	Official action
1	1930–1949	Establishment of the Semashko system of healthcare
2	1990–1999	Codification of free universal healthcare (1993 Russian Constitution); Law on Health Insurance (1991); economic shock therapy for the healthcare system (first half of the 1990s); introduction of chargeable healthcare services (1996)
3	2000–2007	Restoration of an increase in health expenditures
4	2005–2006	National Priority Project on Health (2006); beginning of health protection campaigns: (1) pro-natalist, (2) pharmaceutical regulations and price controls, (3) HIV/AIDS and TB prevention
5	2005–2013	Federal and regional programs for the purchase and renovation of equipment in public medical facilities
6	2008–2010	“Single channel” healthcare system financing reform
7	2013–2020	National Priority Project on Health to 2020
8	2013–2025	Strategy for supplying drugs to the population of Russia to 2025 ^a
9	2018–2024	National Priority Project on Health and the State Program for the Development of Healthcare to 2024 ^b

^aAvailable online at: https://rg.ru/pril/article/70/89/78/Strategiya_Lej_obespecheniya_131112.doc.

^bAvailable online at: <https://minzdrav.gov.ru/ministry/programms/health/info>.

to Innovations, which aim to provide financial services (Sparks-Marketing, 2021). This communication focus was even commented upon by Vladimir Putin as the difference between the ASI and Skolkovo: “Skolkovo ... aimed to gather interesting people and important projects on a well-equipped platform. Here, in ASI, we are talking about ... networking throughout the country” (Lenta, 2020).

The ASI was created in 2011, Freinkman and Yakovlev (2014) defined it as a new type of institution for state-business cooperation; its goals consist not of distributing budgetary funds but of organizing a strategic dialogue with the private sector and reconciling positions within the government (Freinkman and Yakovlev, 2014). The NTI was established by the ASI in 2014 on the example of the European Technology Platforms (Strigin, 2016) and programs for the digital economies of the US, the UK, Singapore, and others (Veduta, 2017). The NTI’s framework targets “innovation activity” (Oveshnikova et al., 2017) and has a predominantly “export or import-substituting orientation” (Blagov and Kulaeva, 2020). In 2021, there were 2,400 companies associated with the NTI whose combined revenue was RUB 639 000 million (approximately USD 8697 million; TASS, 2021).

A special aspect of the NTI, the HealthNet roadmap, has directly developed “personalized medical services and medicines that provide increased life expectancy, as well as new effective means of preventing and treating” (Healthnet, 2017). The HealthNet roadmap was signed into law in 2016, but its history begins in 2013 (Healthnet, 2017). This study utilizes the analytical concept of concentric circles to investigate the promotion of HealthNet. The investigation focuses on HealthNet itself when information is available, but it also explores a proto-HealthNet as well as health-related news on the NTI and ASI websites and their Facebook (Meta) pages in the decade from 2011 to 2021.

This complex sample of material is compared with the national mass media’s agenda concerning healthcare. To this end, we focus on two prominent Russian newspapers: *Rossiyskaya Gazeta* and *Kommersant*. In a separate study (Marchenko et al., 2021), we showed the Russian health news agenda in 2010–2015 included such the topics as criminality and

“modernization” of the state healthcare system. In 2010, the “single channel” healthcare system financing was implemented throughout Russia (Table 1), which created many problems concerning how to finance medical organizations in provinces and regions distant from Moscow. In the mid-2010s, the news media paid less attention to health. There was a gap in the number of thematical journalistic texts because of an external political crisis. After 2016, we detected new trends related to digitalization: drug e-labeling, new drugs, networks, and database development.

Implemented in 2017, the Russian state program of drug e-labeling, as well as the import substitution process, exerted a massive influence on the communicative environment. The number of texts related to private initiatives and their regulations increased significantly in the second half of the decade. These trends could signify not only the centralization of the healthcare system, one of the negative consequences of the single channel reform, but also a shift from physical localization of medical services to online healthcare. Public finance issues prevailed over public health issues.

This shift has remained until the present. The pandemic instantiates a health issue that is a concern in the field of international affairs, which is indicated by the inclusion of foreign countries like China and the US, international exchange to combat the current pandemic, and “new/old” geopolitical tensions. The new most popular words that appeared were “domestic,” vaccine, and “borderline.” However, in main, the national health news agenda continued.

The mass media agenda is associated with social politics (single-channel reform, competitive recovery of Russian pharmaceutical enterprises, and import substitution) and economics (governmental control, drug e-labeling, redistribution of public funds, and other social processes). Below, we consider the role of NPOs in this agenda. We compare NPOs and mass media communications, distinguishing between communications NPOs made as promoters of state influence on the economy and the agenda of national mass media as a reflection of all potentially significant social and economic

facts. The sample description and text mining tools are described below.

MATERIALS AND METHODS

Data Collection

The dataset was collected automatically for the period from 2011 to 2021; it was collected from the websites and Facebook (Meta) pages of the NTI and ASI. Some pages were specifically concerned with the HealthNet roadmap, while others were concerned with innovative activity in general. From the latter, we extracted texts related to the health agenda. The structure of the dataset is presented in **Table 2**. The instruments used for text extraction from the sites were Instant Data Scraper and Octoparse; for the Facebook pages, we used Popsters (<https://chrome.google.com/webstore/detail/instant-data-scraper/ofaokhiedipichpaobibbnahnkdoiiah>; <https://www.octoparse.com/>; <https://popsters.ru/>).

We began with the site of the Infrastructure Center of the HealthNet roadmap of the NTI. Its direct objectives are “assistance in promoting innovative projects, consulting, and analytical support for researchers and entrepreneurs engaged in the development and implementation of future technologies in healthcare” (Infrastructure Center, 2021). Then, we collected the texts from the networks surrounding the NPOs according to the principle of concentric circles, from HealthNet roadmap communications to general health-related news for the NTI and ASI up to 2011. There had to be at least two sources for a year to be included (**Table 3**).

For ease of comparison to the national mass media agenda, we extracted paragraphs from all texts using the same keywords we used in Marchenko et al. (2021): medicine, health, healthcare (health protection), medicine (drug), and hospital.

Text mining was performed using several tools, which increased confidence in the results: topic modeling using LDA, and an algorithm for keyphrase extraction visualization. All texts in the dataset were lemmatized and tagged with parts of speech using PyMystem3 (<https://pypi.org/project/pymystem3/>).

LDA Modeling

This study employs a conventional topic modeling scheme based on LDA (Blei et al., 2003). As indicated by Hagen (2018), properly trained and evaluated LDA-based topic models are powerful tools for content analysis in the social sciences, as they help find themes overlooked by human coders and are less prone to bias. LDA is a particularly popular unsupervised parametric approach that models documents as mixtures of topics, and topics as mixtures of words (probabilistic distributions over words). For a given time span, each document D from the collection was assumed to have a distribution over k topics, where discrete topic distributions were drawn from a symmetric Dirichlet distribution.

We reviewed recent papers reporting on the application of two widely used LDA-based packages, Java-based Mallet (<http://mallet.cs.umass.edu/>) and Python-based Gensim (<https://radimrehurek.com/gensim/>) and extensively experimented with both packages using the same data followed by visualization in

LDavis (Sievert and Shirley, 2014). Ultimately, we selected the Mallet package to compare the tools and indicate that they have their strengths and weaknesses. Mallet’s underlying approach relies on Gibbs sampling, which has well-known implications for runtime complexity (Jelodar et al., 2020) because the training process requires keeping the entire dataset in memory. However, as shown by Zhou et al. (2020), Mallet performs better than Gensim from the perspective of coherence value. Coherence roughly reflects the degree of mutual support between subsets (word sets) within each topic in a topic model. The c_v coherence used in this study combines the indirect cosine measure with the normalized pointwise mutual information and Boolean sliding window, and it is reported to be the best measure regarding runtime and correlation to human ratings (Roder et al., 2015). Dataset pre-processing for LDA included lemmatization with PyMystem3, Russian stopword removal using Natural Language Toolkit (<https://www.nltk.org/>), and bag-of-words representation using Gensim libraries. The best LDA setup was as follows: we used asymmetric alpha (prior to topic proportions within documents), which, combined with symmetric beta (prior to word weights in topic distributions), proved to enhance the quality of topic models. In Mallet, alpha can be optimized for each N iteration by setting the optimized interval parameter to equal N . In the field, although frequent alpha optimization in Mallet increases coherence, it affects topic quality because of the growing prevalence of topics with small coverage (topics that are present in a few documents; <https://dragonfly.hypotheses.org/1051>). Because we aimed to capture the most prominent topics, less frequent optimization was prioritized.

The optimal number of topics for each time span was searched for in the interval 2–50 with varying optimization intervals (10, 50, 100, 500, and 1,000). A wider search interval was avoided because, as observed in Porter (2018), selecting too many topics leads to overfit. In addition, a few topics ensured explicability and efficient analysis of each topic. We consider the best number of topics to correspond to the best c_v coherence value, which is consistent with several studies, including Zhou et al. (2020) and Fang and Partovi (2020). In addition, if a coherence peak that includes the highest coherence value is shared by the LDA runs with different optimization interval values, it is considered to indicate the best number of topics. The resulting optimal number of topics for this study was 30. LDA topics are represented by a distribution of all tokens (words) in the vocabulary, and LDavis represents the percentage of tokens covered by each topic (topic proportions in the dataset).

Keyphrase Modeling

Keyphrases were extracted from texts as multi-word continuous sequences of nouns and adjectives separated by punctuation and words with parts of speech other than those mentioned. For each text, the corresponding list of keyphrases was then extended using sequences of two or more words. These word sequences must be presented in their exact form in any keyphrase extracted from a given processed text and must occur more than once as a subsequence within other keyphrases extracted from the text of the dataset. Keyphrases signifies the combination of keyphrases and the extracted word sequences.

TABLE 2 | Sample sources and period and number of extracted texts.

#	Source	Period	Number of texts
1	Infrastructure Center of HealthNet road map of the NTI, news (news media about HealthNet). http://healthnet.academpark.com/news/smi-o-khelsnet/	Dec. 17, 2018–Oct. 1, 2021	220 ^a
2	NTI “new” site, HealthNet tag https://news.nti2035.ru/tag/healthnet/	Aug. 27, 2020–Oct. 16, 2021	26 ^a
3	NTI Facebook “new” account https://www.facebook.com/2035nti/	Mar. 2, 2015–Nov. 18, 2021	3,731 ^b
4	NTI “old” site news (market chronicles) and HealthNet tag. https://ntinews.ru/news/khronika-rynkov-nti/healthnet/ and https://ntinews.ru/search/?tags=XeπcHet	Dec. 7, 2017–Apr. 21, 2020	157 ^a
5	NTI Facebook “old” account https://www.facebook.com/ntinewsru/	Nov. 7, 2018–Apr. 3, 2020	764 ^b
6	ASI site news. https://asi.ru/news/	Jul. 11, 2011–Dec. 29, 2017	2,086 ^b
7	ASI Facebook. https://www.facebook.com/asi.russia/	Jun. 21, 2011–Dec. 30, 2014	3,262 ^b
		Total	10,246

^aOnly the texts concerning the HealthNet agenda were separated and extracted.

^bTexts concerning the general agenda of the NTI and ASI were extracted; but only the paragraphs mentioning health-related keywords were used for the analysis.

TABLE 3 | Representation of sources per year, 2011–2021.

#	Year	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011
1	NTI sites	31	170	169	29	4	-	-	-	-	-	-
2	NTI Fb	1,062	821	1,193	395	394	273	357	-	-	-	-
3	ASI sites	-	-	-	-	310	343	368	427	339	258	41
4	ASI Fb	-	-	-	-	-	-	-	846	952	1,214	250
	Total	1,093	991	1,362	424	708	616	725	1,273	1,291	1,472	291

The proposed algorithm was derived from the concepts of the Rapid Automatic Keyword Extraction algorithm (Rose et al., 2010), which was combined with the strategy of extracting the most frequent word sub-sequences rooted in category-based search systems that automatically generated named categories using search results (Bernardini et al., 2009). The Rapid Automatic Keyword Extraction algorithm extracts keyphrases from the text as contiguous word sequences separated by punctuation and terms from the extended stopword list. The extended list includes terms that are found more often next to a keyphrase than inside one and whose frequency is above a given threshold. This list is assumed to be universal for a domain of knowledge. In Rose et al. (2010), it was employed for keyphrase extraction from academic papers. However, it requires a domain-specific collection of documents with keyphrases labeled by domain experts. Since there is no corpus available for our study and its construction is beyond the scope of this paper, an alternative was found that exploits an important observation concerning part-of-speech restrictions on the keyphrase extraction field. According to this observation, keyphrase extraction quality increases significantly when only nouns and adjectives are allowed within the keyphrases (Zesch and Gurevych, 2009). Therefore, all words with parts of speech other than nouns and adjectives were considered additional separators. Another key observation we exploited was that

keyphrases should be multi-word because of there are few single-word keyphrases and the percentage of false positives is much higher than it is with multiword keyphrases (Popova and Khodyrev, 2014).

In **Figures 2, 4, 5B**, the keyphrases are vertices and edges that connect phrases that co-occur in more than a certain number of text. For example, in **Figures 2A, 4**, we observe the phrases that co-occur in more than 10 texts; in **Figure 5B**, there are more than eight texts; and in **Figure 2B**, there are more than four texts. This number is higher when there are more texts in the sample, and the homogeneity of these texts is higher.

RESULTS

We identified a proto-HealthNet roadmap agenda in a communication with the ASI in 2011. The word “roadmap” relates to creation of a “project way of thinking” (see **Figures 1A,B**). “Project” had two connotations. On the one hand, it relates to solving medical organizations’ problems. Related words were “region,” “city,” “country,” “modernization,” and “development.” On the other hand, “project” was also related to “production,” “business,” and “construction,” different pro-government councils and roadmaps activities. This is clearer in topics 1–2 of the analysis of the Facebook posts (**Figure 1B**). Regional problems are covered directly only in topic 12 of the

analysis of ASI's website. Its keywords are "non-governmental," "private," "compulsory medical insurance," "organization," "financing," "cost," and "increase" (Figure 1A).

We call this the project way of thinking because it was associated with a wide circle of general social issues, including children, retirees, and disabled people. Words like "technology" and "new" began to be used, but they were not related to anything concrete. We also identified the use of the titles of universities and education and science organizations (Figure 1B, topics 5–6). However, the Russian Academy of Science was not included, which means that the ASI preferred primarily educational partners over scientific ones.

During and after the crisis of the 2014 transition, we continued investigating ASI site news and began investigating NTI Facebook accounts, which were available from 2015. For this comparison, we preferred keyphrase modeling; it was more applicable because of the compact size and greater expressiveness of the model (Figures 2A,B). The results revealed that the ASI agenda had, for the most part, not changed. The project-oriented approach only changed its quality-of-life paradigm, and a national interest was added, which was mentioned by President Putin (Figure 2A). Both phenomena can be explained as a reaction to the implementation of sanctions and the internal need for material (industrial) and spiritual compensation, related to the honor of the nation. In addition, ASI's retention of the same theme may have been determined by the delegation of concrete health issues from the ASI to the NTI.

In 2015, NTI's Facebook account posted about the development of relationships with universities as well as concrete vectors of the health market. These posts concerned the following aspects of e-health: digital and information technologies and artificial intelligence; databases of medical knowledge, including e-documentation in hospitals; and the organization of communication with the developer (Figure 2B).

For the previous period, we identified the development of the health market from non-concrete projects in a wide ring of social issues to choose the main vector. The following analysis of the LDA vision of NTI Facebook accounts (2015–2019, Figure 3A) and news on its website (2017–2019, Figure 3B) reflects the vector of the Russian health market transformation in the second half of the decade. In Figure 3A, one main topic included the words "technology," "project," "company," "applied," "task," "scope," "result," and "artificial intelligence." Among other topics, we also highlight one (topic#5) that develops the IT theme and includes the words "data," "system," "diagnostics," "analysis," and "digital."

The content on NTI sites comes from the end of 2017, 2 years after the NTI Facebook posts. The content was more diverse, which may be because of the 2 years that had elapsed in the development of HealthNet as well as the website's style of presentation (Figure 3B).

The most prominent theme on the site is that of healthcare personalization. This theme displaces geographical items, which were previously more widely used in relation to the state modernization of financing medicine (single channel reform). Personalization is associated with IT (see topics 2–3, Figure 3B),

and, as we assumed and mentioned in the Introduction, a shift from the physical localization of medical services to online healthcare. Additionally, a response to the need for compensation concerning sanctions continued to produce frequent mention of "world," "international," "Russia," "national," "first," "new," and others.

Figure 4 illustrates the keyphrase model and the core themes from the NTI sites in 2017–2019, including IT and the development of new drugs. However, the space above these core themes contains the next five large plots (full graph in bottom left corner of the figures):

- Creation of a community of healthcare professionals, international communication, a national association developer, and a national medical knowledge database;
- Participating in the NTI basic research medicine and clinical trials; in the state medical policy, improvement legislation, registration of medical products, and support for decisions; and the development and creation of new medicine and products;
- Partnership with state universities, a Russian venture company, the Foundations for Assistance to Innovation, international healthcare clusters, scientific institutes of chemistry and biology, and even a the technopark of the Russian Academy of Science;
- Implementation of AI technology, data bases, electronic medical cards, and biomedical products and materials;
- Finally, the creation a scheme of subsystems as a framework for roadmaps, infrastructure centers, and working groups.

The pandemic has not provided a significant change in the NTI's map of health communication. The number of Facebook posts concerning the development of the market are approximately an order of magnitude greater than the amount of news on the sites; therefore, we selected the Facebook posts as examples. Figure 5 indicates two trends, the first of which is a deeper concretization of tasks and technologies. This is illustrated by such words as "direction," "framework," and "competition" (Figure 5A, topic 2), as well as "monitoring," "artificial intelligence," and "machine learning" (Figure 5B). The second trend is the promotion in 2020–2021 of new subcommunities and sub-NPOs to develop additional subtasks (e.g., NTI's elimination of the ASI in 2015), which is evinced by such terms as: "center of NTI," "infrastructure center," "center of competences," "roadmap," "working group," and "foresight" (Figure 5B).

Thus, this overview of the history of the promotion of techno-scientific biomedical communication by pro-government NPOs indicates that the ASI's actions are of paramount importance in the first period. In 2011–2014, the project way of thinking mainly promoted general private health initiatives. The 2014 geopolitical crisis introduced the topics of national interest and import substitution. Subsequently, the NTI searched for a concrete model of high-tech development of the health market. Closely to 2017–2019, this model was clearly focused on e-health. Finally, during the pandemic, the NTI has not changed significantly, but it has proposed and

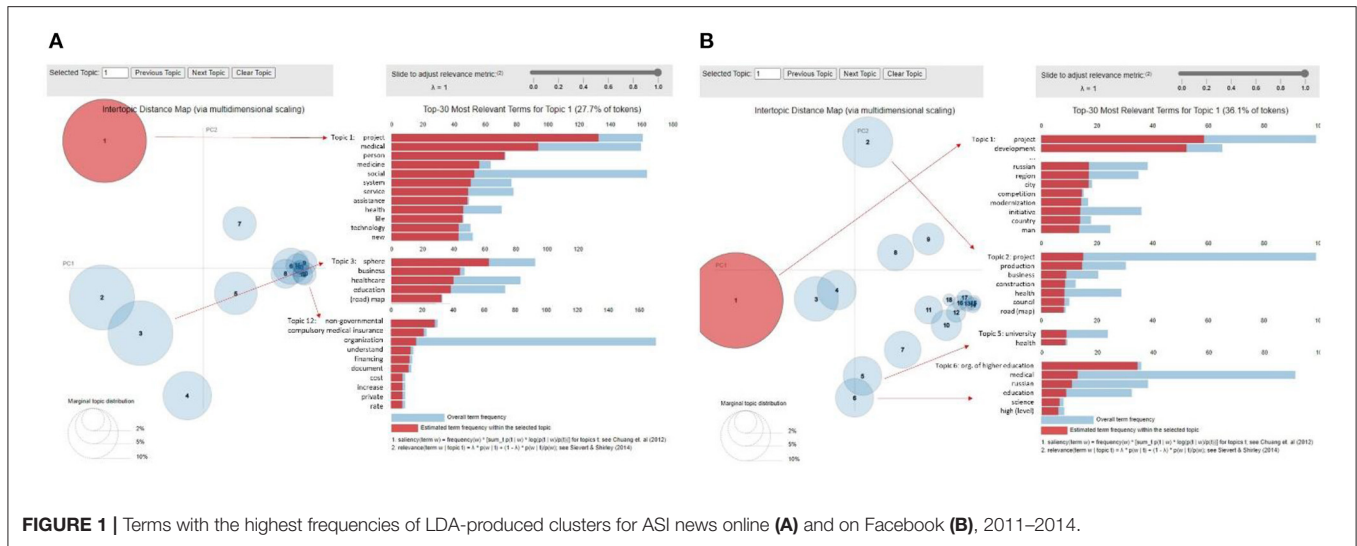


FIGURE 1 | Terms with the highest frequencies of LDA-produced clusters for ASI news online (A) and on Facebook (B), 2011–2014.

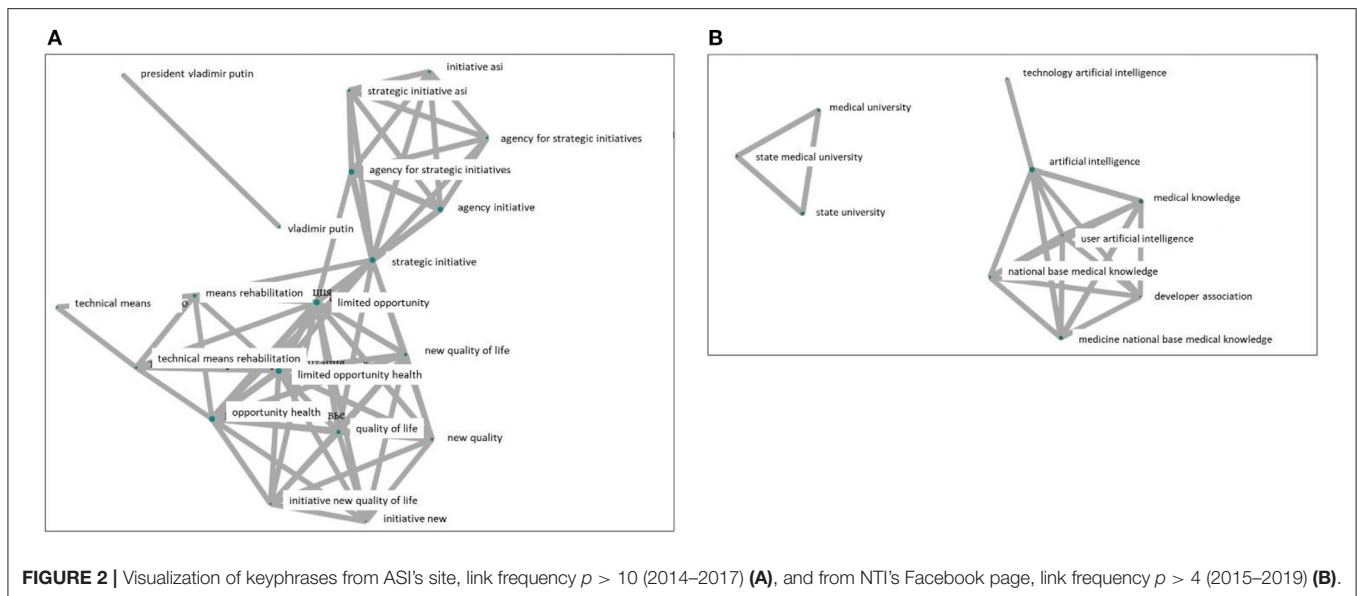


FIGURE 2 | Visualization of keyphrases from ASI's site, link frequency $p > 10$ (2014–2017) (A), and from NTI's Facebook page, link frequency $p > 4$ (2015–2019) (B).

promoted a subcommunities devoted to the development of new subtasks.

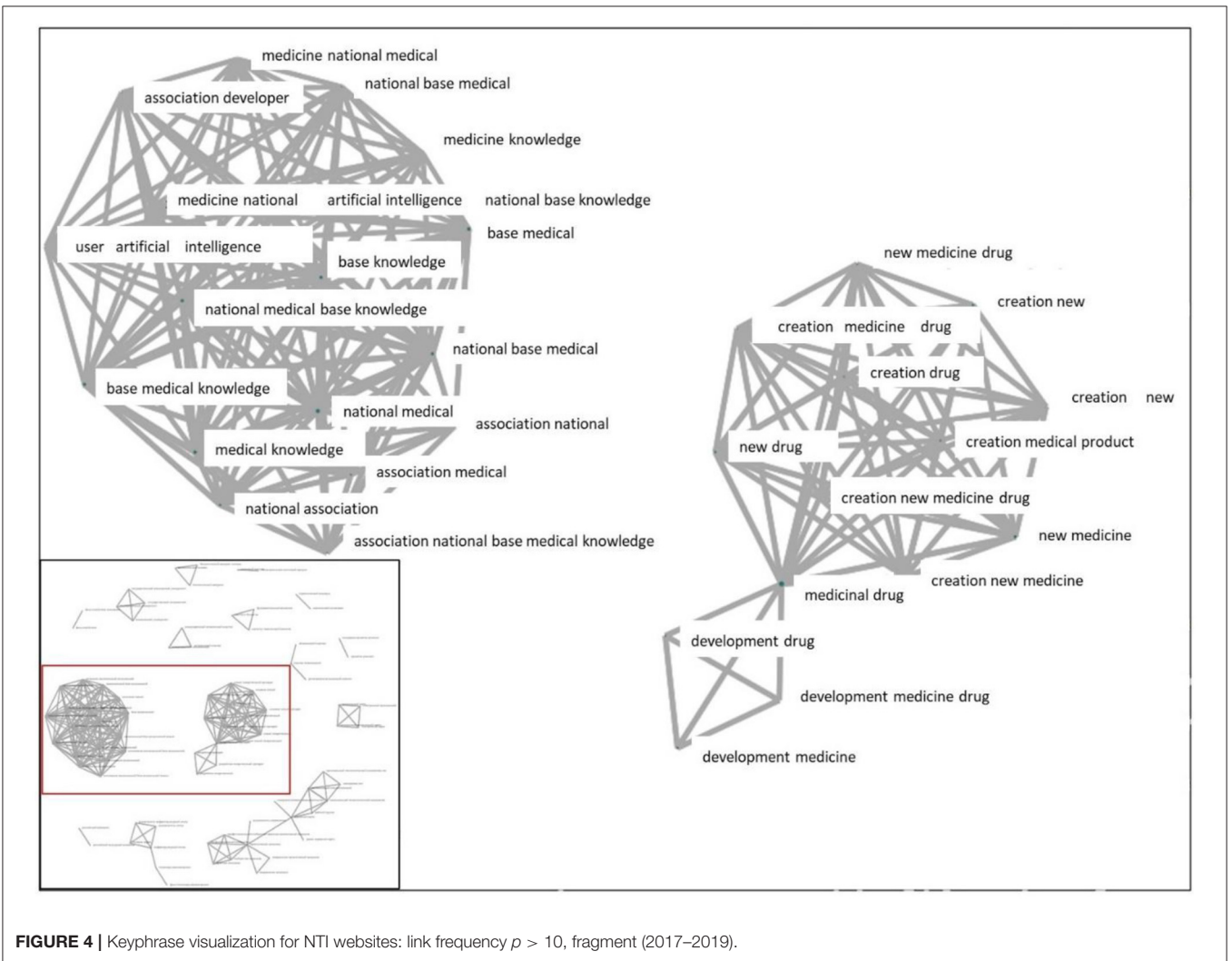
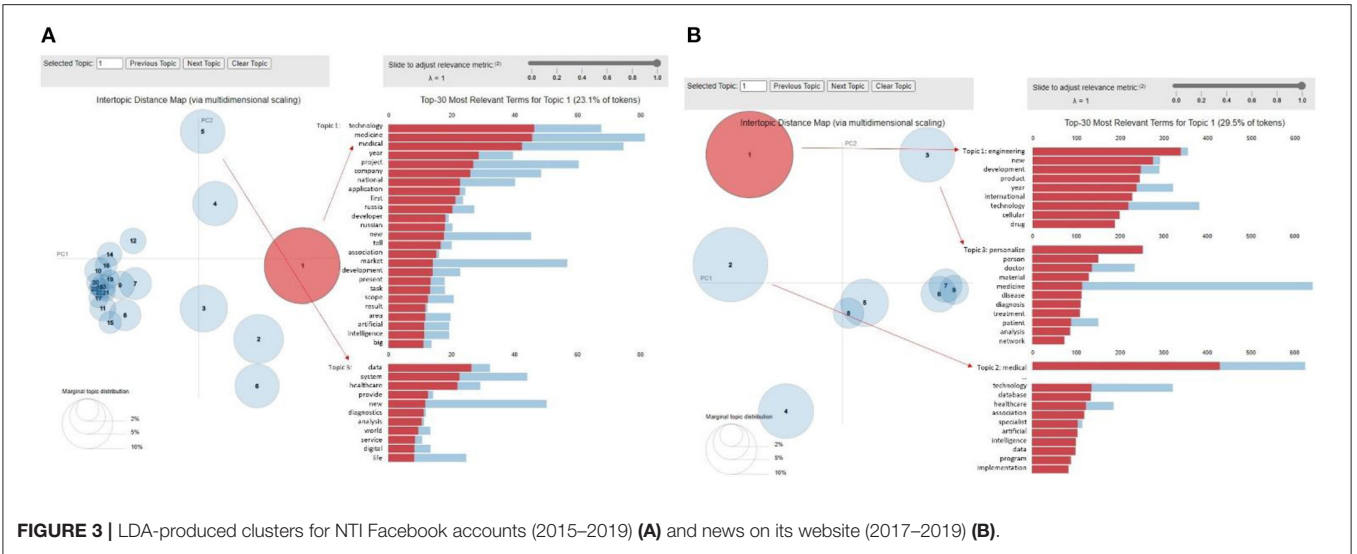
DISCUSSION

The study reveals that the claim that the focus on high-tech medicine is novel and that it is driven by the pandemic is unreasonable. Changes in forms of communication between states, science, and entrepreneurship uncovered during the pandemic had been prepared beforehand. The initiation of such communication changes is likely related to a more general timeline to restore and increase health expenditure in the second half of the 2000s (Shishkin and Vlassov, 2009; Cook, 2015). In 2011, we observed

this with the first news of the ASI on its website and Facebook account.

The study has identified a proto-HealthNet agenda as a “project way of thinking” in the first half of the 2010s. “Project way of thinking” combines both medical organizations’ problem solving and private activities in health. It corresponds to scientific results, obtained by Zemtsov with colleagues. Zemtsov points out that R&D spendings are not the main factor of growth in regional innovation. His econometric analysis shows that “the quality of human capital, a product of the number of economically active urban citizens with a higher education (the so-called creative class) has the greatest influence...,” more than the government spending (Zemtsov et al., 2016).

The techno-scientific biomedical communication development in Russia to some level corresponds to other neighboring countries. For example, the ASI was created in



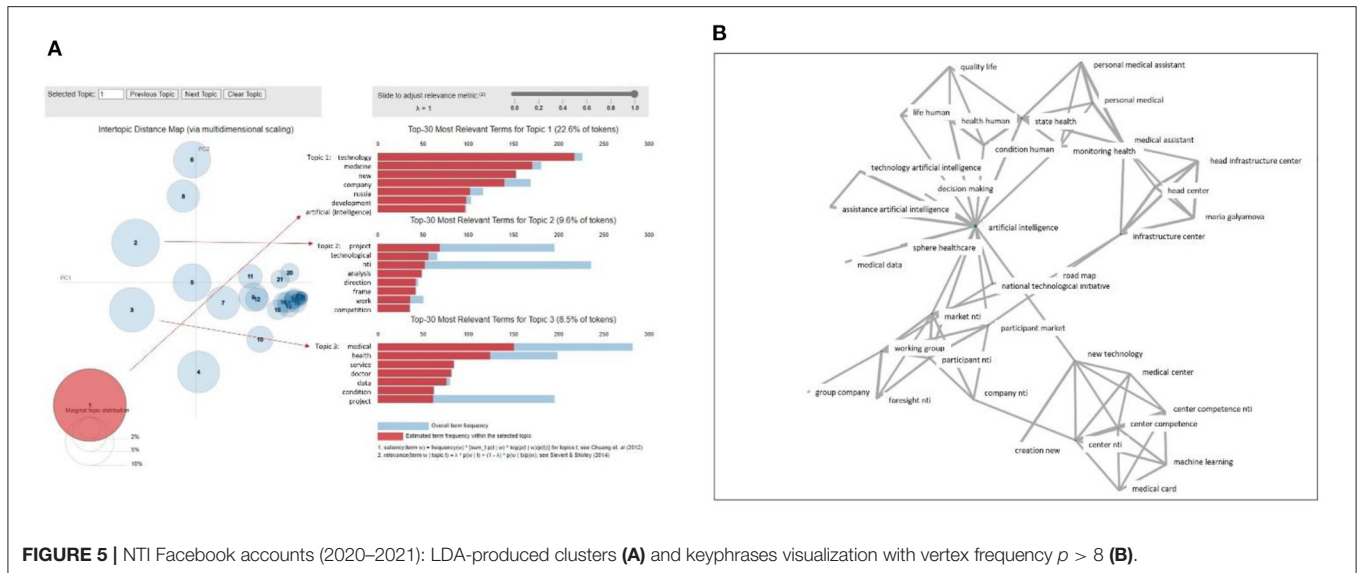


FIGURE 5 | NTI Facebook accounts (2020–2021): LDA-produced clusters **(A)** and keyphrases visualization with vertex frequency $p > 8$ **(B)**.

2011 as a new type of institution for state-business cooperation (Freinkman and Yakovlev, 2014). The NTI was established by the ASI in 2014 on the European and other overseas examples (Strigin, 2016; Veduta, 2017). In this regard, innovation NGOs in Russia have been established about 10 years later than in Europe. For example, in Europe innovation was the cornerstone of the Lisbon strategy, formulated in 2000 (Filos, 2004). However, the development of a model for high-tech development by NTI in Russia corresponds in time to the concept of Digital Innovation Hubs (DIH), launched by the European Commission in 2016. Their functions are similar: “Through a DIH, an organization can thus connect with investors, access knowledge about digital transformation, connect users and potential partners, as well as refine their business and marketing development strategies” (Georgescu et al., 2021). At the same time, closely to 2017, the NTI clearly focused on e-health as a model for Russian health market development.

The communication of pro-government NPOs with universities, education, and scientific organizations corresponds to the experience of other neighboring countries such as Finland and Poland. In Finland, the project “Open innovation platforms” (OIPs) provides interactions between science, education, and innovation, and use the urban environment as a “living lab.” And at least three universities implementing this strategy (Raunio et al., 2018). The same pieces of evidence with assent to the foresight in higher education institutions can be found in Poland (Ejdys et al., 2019). Russian communication practices tend to follow the framework of its neighbors of Central and Eastern European (CEE).

So, to answer the first research question, it has showed that the transition has begun long before the pandemic situation. We describe the main stages in the development of health communication of the ASI and NTI.

- 2011–2014: The ASI, a proto-HealthNet, which primarily promoted general private health projects

- 2014–2017: The quality-of-life paradigm, and national interests, and the initial search for an attractive model for the health market
- 2017–2021: Mature HealthNet communication with core themes of IT and the development of new drugs; additionally, community building, taking part in fundamental science and decision making of the government, and finally, the creation of a scheme of subsystems for the health market NPOs.

The crisis of 2014 had a strong negative impact on knowledge-intensive business services, and the share of companies with decreasing revenues has dramatically grown in all industries (Belousova and Chichkanov, 2016). Before and after this crisis, the main stages of the development of health communication are similar to historians’ periodization of the three stages of Russian modernization during the 2010s: “The first period was characterized by the fact that modernization was more declarative than practical’ (final of 2000s and start of 2010s); the second was a practical implementation of modernization with discussions and searches of attractive models (mid of 2010s); and the third period, which continues to the present moment, does not need discussions, but doing business only” (Kruglikova et al., 2021).

To answer the second research question, we point out that the content of the communications, particularly those of the ASI and NTI, were not directly determined by the state’s power. For example, proposing or preferring an e-health market was not temporally related to official policy based on laws and programs (see **Table 1**; Gordeev et al., 2011; Cook, 2015; Endaltseva and Mordvinova, 2015). Single channel health financing reform received little coverage in the news on the ASI site, but so too did the national priority health projects for 2020 and 2024.

We completely agree with the conclusion that the promotion of high-tech healthcare is related to governmental institutions concerns about import substitution owing to the 2014 geopolitical crisis (Belousova and Chichkanov, 2016; Endaltseva,

2020). However, as this study reveals, communication between states, science, and entrepreneurship began before this crisis, and it continues into the present for reasons other than import substitution. Furthermore, it is reasonable to claim that significant issues, such as the 2014 geopolitical crisis and the pandemic, created a primary framework for change in this field. For example, with respect to the former, the national mass media turned to e-health, and the NTT's HealthNet roadmap was created based on the ASI. The pandemic should also significantly influence the current state of e-health communication, but it will be interrelated with other political, social, and economic factors.

So, we tested and confirmed the hypothesis of the rooting of the e-health promotion in long-term communication, which creates, maintains, and transforms social and economic practices (Carey, 2009). This conclusion contributes to the many previous works, in which communication factor in innovations has been considered. For example, Butenko considers how Russia adopts the foreign experiences of the digital economy development (Butenko et al., 2021). Communication factors in innovations as eHealth literacy or consumers' trust, achievement of societal benefits, and subjective wellbeing were indicated as significant for Europe (Birch et al., 2014; Ricard, 2016; Griebel et al., 2017), as well as for emerging economies and developing countries (Marten et al., 2014; Hoque et al., 2017; Bosch and Vonortas, 2019). Some studies check these factors based on methods of a survey (questionnaire) or analysis of macro data of a monitoring report (Marten et al., 2014; Zbierowski, 2017; Elmassah and Hassanein, 2022). For example, Zbierowski (2017) investigated the possible impact of new technology-based firms (NTBF) on the social and economic development of eight countries of CEE and Russia and Kazakhstan as the countries of the Commonwealth of Independent States (CIS). Zbierowski has found that Russia was the lowest country almost in all measurements, although they were based on "the entrepreneur's self-assessment" (Zbierowski, 2017).

Comparing texts from non-profit organizations' websites and Facebook accounts with official state actions and the national mass media health agenda, we have found that they all aim to rise self-assessment. Our study indicates that the common development of these agendas significantly contributes to the trust in innovations. Additionally, the study contributes to the investigation of impact of digital data sources such as social media platforms, electronic health records (EHRs), websites and mass media on people's health. The key impact of these sources is "in the area of infectious diseases and early warning systems, and in the area of personal health, that is, on mental health and smoking and drinking prevention" (Li et al., 2021). The NPOs are able to use communication in social media and by websites to promote the topic of personalization and digitalization of health, as well as for eHealth literacy.

Answering the third research question, we found that the non-profit organizations' impact on the general national health agenda was not as significant as mass media. The non-profit organizations could not provide long-term predictions that the mass media could widely and quickly disseminate. They also did not alter the national agenda for the healthcare system reform, or at least we did not find evidence for this. Finally,

the non-profit organizations and the mass media went through different stages in the history of health communication. The non-profit organizations were the first to propose a general private model for the health market, then searched for a specific model, and finally, shifted to digitalization. The media covered modernization reform without either proposing or searching for a model; and then, after a period of silence in the middle of the decade, reoriented themselves to digitalization.

Although NPOs' power of communication is not very significant, when it corresponds to political, social, and economic changes, it plays a more significant role in the transformation of society. This correspondence explains why NPOs and the mass media both finally focused on e-health as their new agendas in 2017–2019, before the pandemic. This dynamic has also continued until the present. Mass media queries NPOs for information and analysis, this information and analysis is reinforced by the media, and together, they create a communicative environment for the transformation of business models. This conclusion corresponds to the previous works on relationships between health news coverage and wider historical transformations in the social organization of health and medicine (Hallin et al., 2013, 2020).

LIMITATIONS OF THE STUDY

For this analysis, the posts from Facebook and websites of Russian NPOs were chosen which are likely to influence techno-scientific biomedical communication in Russia. However, it would be inaccurate to assume that the results from this study refer to the public discourse on the topic. We don't analyze a many different kinds of actors, only NPO and news media. There are too many other players in the health industry which participate in techno-scientific biomedical communication in Russia. The list of potential participants includes: governmental institutions and officials, which exercise the strategy dictated by state policies; patients' groups and associations; pharmaceutical industries; marketing and public relations firms that are outsourced by the industries; NGOs which provide relief and promote self-care; insurance companies and other commercial entities, for example, web platforms and equipment producers; and education and research sector, which uses the current situation to communicate the topicality of medical professions.

Some of these players have been studied before. For example, Endaltseva (2020) points out the role of Russian patients' associations. Activities of pharmaceutical companies were considered by many authors. Rodwin with colleagues argue that "healthcare expenditures in BRIC nations have exhibited the highest revenue growth rates for pharmaceutical multinational corporations. The response of BRIC nations to Big Pharma presents contrasting cases of how governments manage the tensions posed by rising public expectations and limited resources to satisfy them" (Rodwin et al., 2018). Balashova and Volgina express an opinion that Russia, Kazakhstan and Belarus have certain potential to take a leading position in the global pharmaceutical market. It relates to participation in global production and R&D expenditures (Balashova and

Volgina, 2021). In 2020 number of startups has increased in pharmaceuticals by 100% (Zemtsov et al., 2021). Apparently, techno-scientific biomedical communication in Russia is a complicated process which requires future investigation in stakeholders' behavior.

Further limitations refer to the implementation of the content analysis with a conventional topic modeling scheme based on LDA. LDA-produced clusters suggest pictures of semantic relations at the chosen period of time. The algorithm fails to reflect the dynamics of the communication process.

CONCLUSION

This study investigates the decade-long history (2011–2021) of the promotion of techno-scientific biomedical communication by pro-government non-profit organizations in Russia, on the example of the ASI and NTI. We tested and confirmed the hypothesis of the rooting of the e-health promotion in long-term communication, which creates, maintains, and transforms social and economic practices (Carey, 2009). It contributes to the investigation of communication factors in innovations.

The study revealed that the claim that the focus on high-tech medicine is novel and that it is driven by the pandemic is unreasonable. The history of this promotion can be linked to European innovation programs of the 2000s (Filos, 2004), which was reconsidered in Russia and reinforced by the 2014 geopolitical crisis. The NTI searching for a concrete model of high-tech development of the Russian health market may be linked in time to the European digital innovation concepts of the middle of 2010s (Georgescu et al., 2021).

We discussed three research questions. (1) When did the health communications of these NPOs begin and what were their stages of development? (2) What are the determinants of change? (3) What is the extent of the influence of such communication on the national health agenda generally? Answering the first research question, we described three main stages of the development of health communication: (1) proto-HealthNet agenda of 2011–2014; (2) search for an attractive model for the health market of 2014–2017; and (3) mature HealthNet e-health communication of 2017–2021.

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Answering the second research question, we pointed out that the content of the communications was influenced by the authorities, NGOs, private companies, and mass media. Answering the third research question, we found that the non-profit organizations' impact on the general national health agenda was not as significant as mass media. Although NPOs' power of communication is not very significant, when it corresponds to mentioned social and political changes, it creates a communicative environment for the transformation of business models.

As a recommendation for the future, we propose to compare the agendas of non-profit organizations and national mass media to develop understanding of the trust in innovation and eHealth literacy.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found at: Public available page of Yandex.Disk: <https://disk.yandex.ru/d/ORywBgAdltWJhQ>.

AUTHOR CONTRIBUTIONS

AM: conceptualization and original draft preparation. IB: review and editing. All authors have read and agreed to the published version of the manuscript.

FUNDING

This research was funded by the President of Russia Grant, grant number MK-968.2020.6.

ACKNOWLEDGMENTS

We would like to thank Svetlana V. Popova (Technological University Dublin, Ireland; St. Petersburg State University, St. Petersburg, Russia) and Vera V. Danilova (Presidential Academy of National Economy and Public Administration, Moscow, Russia) for use of their software, and Arina V. Senatorova (St. Petersburg State University) for her work on coding the texts of the sample. Additionally, we would like to thank Editage (www.editage.com) and Sam E for English language editing.

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